New Partnership for
Africa's Development (NEPAD)

Comprehensive Africa Agriculture
Development Programme (CAADP)

Food and Agriculture Organization
of the United Nations

Investment Centre Division

GOVERNMENT OF ERITREA

SUPPORT TO NEPAD–CAADP IMPLEMENTATION

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Volume V of V

BANKABLE INVESTMENT PROJECT PROFILE

Zula Plains Integrated Development Project

January 2005

ERITREA: Support to NEPAD–CAADP Implementation

Volume I: National Medium–Term Investment Programme (NMTIP)

Bankable Investment Project Profiles (BIPPs)

Volume II: Hazemo Plains Integrated Development Project

Volume III: Tseada–Kelay Plains Integrated Development Project

Volume IV: Tsilima Plains Integrated Development Project

Volume V: Zula Plains Integrated Development Project

NEPAD–CAADP BANKABLE INVESTMENT PROJECT PROFILE

Country: Eritrea

Sector of Activities: Agriculture

Proposed Project Name: **Zula Plains Integrated Development Project**

Project Area: Northern Red Sea Administrative Region

Duration of Project: Five years

Estimated Cost: Foreign Exchange.....US$43.29 million
Local Cost.....US$10.94 million
Total..... US$54.23 million

Suggested Financing:

Source	***US$ million***	***% of total***
Government	5.42	10
Financing institution(s)	44.14	81
Beneficiaries	4.67	9
Private sector	–	–
Total	***54.23***	***100***

ERITREA:

NEPAD–CAADP Bankable Investment Project Profile

"Zula Plains Integrated Development Project"

Table of Contents

Abbreviations..... iii

I. PROJECT BACKGROUND.....1
A. Project Origin 1
B. General Information.....1

II. PROJECT AREA.....2

III. PROJECT RATIONALE.....8

IV. PROJECT OBJECTIVES.....8

V. PROJECT DESCRIPTION 9

VI. INDICATIVE COSTS 11

VII. PROPOSED SOURCES OF FINANCING 12

VIII. PROJECT BENEFITS 12

IX. IMPLEMENTATION ARRANGEMENTS 13

X. TECHNICAL ASSISTANCE 14

XI. ISSUES AND PROPOSED ACTIONS 14

XII. POSSIBLE RISKS 15

ANNEXES: 17
Annex 1: Map of Eritrea Showing Location of Project Area.....19
Annex 2: Livestock Component Indicative Financial Returns 21
Annex 3: Production Cost of Some Crops Used to Calculate the Financial Results.....23

Abbreviations

AEZ	Agro–ecological Zone
AWPB	Annual Work Plan and Budgets
BIPPs	Bankable Investment Project Profiles
CAADP	Comprehensive Africa Agricultural Development Programme
CBO	Community–Based Organization
EIA	Environmental Impact Assessment
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
HH	Households
IDP	Internally Displaced People
IFS	Integrated Farming Schemes
MoA	Ministry of Agriculture
NCA	Norwegian Church Aid
NEPAD	New Partnership for Africa's Development
NGO	Non–Governmental Organization
NMTIP	National Medium–Term Investment Programmes
ZPIDP–1	Zula Plains Development Project – Phase 1

I. PROJECT BACKGROUND

A. Project Origin

I.1. The above project profile is being formulated within the framework of the *New Partnership for Africa's Development* (NEPAD) to support the implementation of the *Comprehensive Africa Agriculture Development Programme* (CAADP). It is to be recalled that CAADP has been given a strong political support by the Heads of State and Government of the African Union during the Second Ordinary Session in Maputo in July 2003. Among other things, the Heads of State and Government committed themselves to allocate 10 percent of the national budgetary resources to the agricultural sector within five years. To this end, the FAO has been requested to assist the member countries in preparing *National Medium–Term Investment Programmes* (NMTIPs), and a set of *Bankable Investment Project Profiles* (BIPPs).

I.2. The government completed the preparation of the NMTIP for Eritrea with the assistance of FAO in September 2004. As intended, the NMTIP has articulated government's development strategies and priorities and identified major areas for investment in the medium–term, taking into account their relevance to one or more of the five pillars of CAADP. The proposed *Zula Plains Development Project* (ZPIDP–1) has been recognized as one of the priority development areas, and has been selected to become an integral part of the medium–term investment plan as outlined in the NMTIP.

B. General Information

I.3. Eritrea has a total population of about 4.48 million, of which some 70–80 percent is considered rural. Of the total land area of about 12.4 million ha, 1.65 million ha is arable and roughly 0.6 million ha is suitable for irrigation. The area cultivated per year averages about 530,000 ha and only 28,000 ha are currently irrigated, leaving considerable potential for expansion. The country has numerous ecological zones due to its topography, which comprises altitudes that range from sea level to peaks of over 3,000 m above sea level. The diversity of ecosystems makes the country well suited to produce a wide variety of tropical and temperate crops.

I.4. Although the majority of the population lives in the rural areas, agricultural contribution to the Gross Domestic Product (GDP) is relatively modest, accounting for only about 12 percent in recent years. This highlights the low value of agricultural production, reflecting the dominance of rainfed crop production by subsistence farmers and livestock rearing by pastoralists. Yield of crops are very low, varying from 0.2 to 1.5 tonnes/ha depending on rains. Likewise, productivity of livestock is also low being subject to the vagaries of the climate. In the past few years, poor and erratic rains have lead to frequent droughts, discouraging farmers from adopting modern agricultural practices, thus exacerbating rural poverty. In addition to the drought conditions, the country's soils are seriously eroded, particularly in the highlands, as the result of deforestation, overgrazing and inadequate resource management which contributes to low agricultural productivity. Since 1998, agricultural production has also been affected by the war with Ethiopia as many farmers have been displaced and production systems disrupted. The country is dependent on the outside world for food and its annual import requirements vary from 25 to 50 percent, depending on rainfall.

I.5. It is widely recognized by practitioners and policy makers in the country that current agricultural production practices are not sustainable. Therefore, the government has been endeavouring to address the issues related to traditional farming practices and resource conservation in order to improve agricultural productivity. For instance, it launched a major development programme

known as the *Integrated Farming Schemes* (IFS) whose main thrust was to increase crop production through the use of modern farming practices, namely the provision of fertilizers, seeds, machinery ploughing and harvesting services. The result of this programme was mixed but general observations are that little impact was made in the shallow and poor soils of the highlands, which are characterized by erratic rains, while significant yield increases were recorded in the south–western lowlands, where soils and rainfall are relatively better. The same observations were made following the implementation of other development programmes such as *Sasakawa Global 2000*, the FAO *Special Programme for Food Security* and other area specific development programmes.

I.6. A number of useful lessons have been learnt during implementation of these and other similar development programmes in the last decade, including the following which deserve due consideration while designing future development programmes:

- provision of drought resistant crop varieties and adoption of moisture conserving cultural practices are important in mitigating rainfed crop failures when rainfall is below normal patterns;
- whenever possible, efforts should be made to shift farming towards irrigated agriculture (year round irrigation, supplementary or spate–based) to secure harvests;
- promotion of rational range management systems for livestock production in order to utilize such resources on a sustainable basis;
- rehabilitation of the environment for better soil and water conservation should be considered as an integral part of agriculture development; and
- the provision of support services should respond to critical problems of the individual farmers and their communities.

II. PROJECT AREA

II.1. The project area is located in the Northern Red Sea Administrative Region and more specifically in the Zula area of Red Sea coast. The area is dissected by seasonal rivers (Comalle–Gonfale, Haddas and Alighede) flowing from the central highland agro–ecological zone (AEZ) to the Red Sea. Since water is very scarce, the livelihood of the population of the project area is closely associated with the basins of these rivers. The total project area is 15,200 ha and the area for potential irrigation is about 8,000 ha.

II.2. Traditionally the main source of the livelihood of the people in the area is livestock production, which is dominated by small ruminants and camels. Rain–fed cropping is not practiced as the rainfall is too low. The only method of cropping is spate irrigation along the lower basin of the major rivers crossing the plain.

II.3. Since the last four to five years, the project area has been suffering from severe drought and most households have lost their livestock due to lack of feed and drinking water. The spate irrigated cropping system has also been unreliable due to lack of adequate river flows and the inability of farmers to control the water flow. As a result, the livelihood of the population has been severely affected and they are almost totally dependent on food aid.

II.4. The six sites selected within the project area are Gonfale, Ayromale, Zula/Afta, Melka/Adi Umaro, Rubrubia, and Hidelli/Wia.

II.5. ***Location, Land and Population.*** The project area of the ZPIDP–1 is bounded on the east by the Red Sea, on the north by Lahzien, on south by Irafale and on the west by the mountains of Hadas. There are about 6,377 potential project beneficiary households out of which 4,477 are direct beneficiaries and the rest 1,900 households are indirectly befitting from the project. The total direct and indirect beneficiary population is estimated at about 31,190 living in 39 villages.

Table 1: Population and Land Area Use of the Project Area (Hazemo)

Site	Vil-lages (No.)	HH (Nº)			Pop			Land Area to be developed (ha)						
								Irrigated						
		DBHH	IDBHH	TBHH	DBPP	IDBPP	TBPP	Horti-culture	Cereals	Forage	Total	Grazing	Rainfed	Total
Zul–Afta	19	2,270	380	2,950	11,140	3,160	14,300	–	–	–	–	–	–	2,400
Melka–Adi	4	800	–	800	4,050	–	4,050	15	1,233	352	1,600	–	–	1,600
Robrobia	1	220	–	220	1,1003	–	1,100	–	622	178	800	–	–	800
Hidelli–Wia	7	347	1,220	1,567	1,860	6,030	7,890	35	–673	192	900	–	–	900
Ayromale	3	390	–	390	1,650	–	1,950	–	390	110	500	–	–	500
Gonfale	5	450	–	450	2,200	–	2,200	–	390	110	500	–		500
Total	39	4,477	1,900	6,377	22,000	9,190	31,190	50	3,356	944	4,300	–	–	6,700

DBHH Direct Beneficiary Households IDBHH Indirect Beneficiary Households TBHH Total Beneficiary Households

DBPP Direct Beneficiary Population IDBPP Indirect Beneficiary Population TBPP Total Beneficiary population

Note: Cereal and forage crops would be produced under spate irrigation. Horticulture would be produced year round by irrigation.

II.6. ***Physical Characteristics and Climate.*** The topography of the project area is mostly flat; however, the up–stream part of the plain approaching the foot of the Hadas Mountain is hilly. The plain inclines from west to east where the average land slope at the coastal part is 0.5 percent and at the upstream part is about 1.1 percent. The Zula plains are delimited by the Red Sea on the east; the Haddas mountain range on the west; southend foothills of Gedem Mountains on the north and the Comaile/Gonfale Rivers on the south. Altitude of the plains ranges between 10 m near the Red Sea coast to about 250 m a.s.l. near the foot of the escarpment. The soil type is generally transported fine silty loam throughout the plain. The average soil depth varies from 3 m at the coastal part to about 2 m at the upstream part. The texture is medium to light and the organic matter content is low. The climate is generally warm to hot where the average annual temperature is about 29ºC and the mean maximum and mean minimum temperatures are 34ºC and 21ºC, respectively. The coldest period of year is between November and March and the hottest is between May and September. The average annual rainfall is about 175 mm. The rainfall pattern is highly variable and the area is extremely vulnerable to drought.

II.7. The vegetation cover of the plain is of low density and is generally of the "steppe type" in most areas. Due to the climatic features and the acute problem of moisture, the project area is not suitable for rain–fed cropping. The pastoral system is currently unable to support the livelihood of the population due to successive drought years. The only alternative that remains viable is spate–irrigated crop production integrated with an intensified livestock system where both are complementary to each other.

II.8. ***Land Use and Land Tenure.*** Most of land in the project area is used for grazing/browsing with a limited area along the main rivers used for spate–irrigated cropping. All land in Eritrea belongs to the government, however, the land tenure system in the project area is characterized by private ownership. Under this system — the *tsilmi* — land belongs to individual farmers who have the right to

pass it from father to son. This type of land holding system encourages long–term investment on land but due to various factors farmers in the project area have been unable to introduce modern systems of farming. Land tenure is communal in respect to grazing land as opposed to the spate–irrigated land.

II.9. ***Surface Water.*** The project area is served by three major rivers, Alighede, Haddas and Comaile. The three rivers join at the Zula reservoir and are named Hadas River from this point up to their discharge into the Red Sea. All the rivers flow intermittently with periodic flash floods.

II.10. The River Hadas originates in the high mountain peaks south of Adi Caieh, which rise up to 2,500 metres above sea level and flows north to meet River Alighede at the flood plain of Melka, about 19 km west of the shore of Gulf of Zula. Just upstream of the two–river confluence, Hadas passes through a deep and narrow gorge. After passing the Melka plain Hadas River is joined by Saato and Comaile at the tail of silted Zula reservoir.

II.11. The total drainage area of Haddas at the existing silted Zula reservoir is about 2,813 km^2 (Saato 98 km^2; Alighede 1,188 km^2; Hadas 828 km^2; Comaile 662 km^2 and unnamed stream 27 km^2). Flows last only a few hours and occur mainly in July and August with less frequent floods occurring in March, April and May. The total average annual runoff reaching Zula plain is estimated at about 116 million m^3 and this conservatively could irrigate up to about 8,000 ha.

II.12. The present spate irrigated land varies between less than 2,000 ha and 6,550 ha depending on a farm community's success in spate flow diversion and the number of annual floods reaching the sites. In addition, about 50 ha of land are under year round irrigation from pumped groundwater.

II.13. ***Groundwater.*** The major groundwater sources in the project area are alluvial deposits found in the valleys of Alighede and Hadas, particularly at near the foot hills. Water quality is poor especially when pumping from deep boreholes. By intercepting the available base flows and pumping from the top 10 metres of unconsolidated aquifers, it is possible to harvest up to 7.3 million m^3 of water for both domestic and irrigation purposes.

II.14. ***Existing Irrigation Practice.*** Diverting spate flows of major rivers and flooding fields is the common irrigation practice. Spate flows are diverted by temporary bush wood, reinforced with earth and boulders scraped up from the streambed. Uncertainty of moisture, risk of large floods washing away canal intakes, head reach and farm land ; very high conveyance and distribution losses ; and high cost of maintenance are the major constraints in the present irrigation system. Recently farmers have started to irrigate by diverting base flows and pumping groundwater up stream of irrigation fields. However, lack of capital has constrained project area farmers from progressing towards pumped groundwater based irrigation system.

II.15. ***Crop Production.*** The area is arid with very low rainfall for crop production; hence crop production depends on spate irrigation from diversion of river flows coming from the highland. To alleviate the moisture condition and to increase the productivity of the plain a dam was constructed in 1960 for irrigation. The production of the crop during 1960–1970 when the dam was functional was very high and farmers used to produce crops and animal feed throughout the year, however, siltation rendered it inoperable after 1970.

II.16. Extremely low moisture, poor pest management and use of traditional varieties that are low yielding characterize the crop productivity of the Zula plain. In addition, recurrent drought in the highlands of Adi Keih, Senafe, Decamare, Adi Hawush and Ghindae seriously affect the volume of river flow to the project area. In years of good river flows it causes a repeated damage of the diversion structures that results gully formation and erosion within farm and watercourses.

II.17. Currently, crop production is practiced from diversion of rivers Hadas, Ali Ghede and Comaile. Crops grown in the project area are maize, dura (sorghum), sesame and watermelon. Maize is the staple food crop while water melon and sesame are produced as cash crops. Dura is grown for animal feed. Very recently about 1–2 percent of the farmers in Melka–Adi Umaro, Rub–Rubia and Alighede have started to produce horticultural crops, mainly vegetables irrigated from dug wells.

II.18. The productivity of the area depends on the number of flooding events to the farmlands which increases water storage underground. Farmers report a good production year when they have three or more river flow or floods to their farms with five flooding events providing the best production. During good river flow, farmers could have three croppings per year. This is mainly due to the area having a short length of growing period (90 days). In good years the first cropping is from mid–July to early October. The crops produced during this time are dura, watermelon or sesame; second cropping is from mid–October to mid–February. During this period the sole crop cultivated in the area is maize and it covers about 4,000 ha of land. The third cropping is from late–February to May. The main crops grown during this time again are watermelon or dura and sesame. Table 2 shows the yield of crops grown in the valley for seven years to 2003. The actual average yield is very low mainly due to low flooding and low moisture conditions. However, with better river flow or flooding in 1998 and 2001 the yield of the crops was very high and at the same time farmers had three harvests per year. This indicates that with the improvement of the moisture condition, timely pest control and improved cultural practice, yields could be substantially increased and the food security of the valley could be improved.

Table 2: Average Yield of Crops Grown in Zula Valley (in t/ha 1997–2003)

Year	Maize	Water melon	Sesame	Tomato
1997	1.1	3.0	0.4	5
1998	2.6	5.5	0.6	10
1999	1.2	2.7	0.3	6
2000	1.0	3.1	0.4	5
2001	1.8	5.0	0.5	9
2002	1.2	4.1	0.3	6
2003	1.3	4.5	0.2	5

Source: MoA Subzoba Foro

II.19. ***Livestock Production.*** The livestock system in the project area has experienced periods of intensification and decline over time. The traditional source of livelihood was pastoral but after the Zula dam was constructed during 1958–1960 spate–irrigated cropping increased. This activity has spread further along the main river basins.

II.20. The agricultural systems include mixed crop–livestock and pastoral systems where cropping is based on spate irrigation. The livestock system is based on extensive land use, but limited production is also carried out under semi–intensive system mixed with cropping in the spate irrigated farms. The evolution of the production systems has been under the influence of droughts over the past few years. The pastoral system has failed to support the livelihood of the populations because of successive drought. The crop/livestock system has not been quite successful because of inadequate annual river flows (four to five flows per annum being optimal) from the highland area and the inability of the farmers to control the river water flow while the livestock element of the crop–livestock system is too small to effectively contribute to the livelihood. The pastoral system which was the traditional source of living is no longer sustainable because of lack of feed and drinking water due to persistent drought. During the last four to five years, vegetable production using wells has also started in at least two sites (Wia, Robrobia) as a sign of insecurity of the spate irrigation. All the

systems, being traditional, are sensitive to drought and are unable to ensure the livelihood of the population on a sustainable basis.

II.21. The livestock species raised in the project area are of the indigenous types of goats, sheep, cattle, and camel which are well–adapted to the harsh area environment. Donkeys are kept for water transport. The estimated animal population in the selected sites of the project area are 8,988 goats, 7,871 sheep, 2,173 cattle, 651 camels and 636 donkeys. The total animal populations of the project area are 54,300 (goat), 48,300 (sheep), 27,210 (cattle), 7,219 (camel) and 8,500 (donkey).

II.22. The livestock systems practiced are of extensive, and the semi–intensive systems, but the latter is of small magnitude. In the extensive system, cattle production involves long distance movements regulated by rainfall intensities and spread in both the project area and in the central highland such a Hazemo and Ubel. Cattle graze in the Wengebo area (southwest of the project area) between October and April, (wet season of the project area); between June and September in the Hazemo/Ubel valleys. They stay briefly in the project area in between these two periods. The small ruminants and camel remain in the project area with limited movements towards the upper catchment.

II.23. In the mixed crop/livestock semi–intensive system, few goats, cattle and sheep are kept indoors primarily under hand where the source of feed is the spate–irrigated land. The system is largely based on the forage crop (dura) grown under irrigation and crop residue such as maize stalks, weeds and aftermath grazing. Feeding is supplemented by a brief grazing period during the rainy season in the marginal land surrounding the homestead.

II.24. The livestock population in the project area has been greatly reduced during the past four to five years due to successive drought occurrences. Many of the animals in the pastoral system died due to persistent lack of feed and drinking water; many others were sold at low prices to save capital. As a result, many households remain either without any animals or with fewer animals. The animals under the mixed crop/livestock system were also equally affected by drought due to the reduced annual river flows from the central highland and the inability of the farmers to control the water, which lowered the spate irrigated cropping and influenced feed supply availability.

II.25. The main factors constraining livestock production in the project area include lack of feed and water; infectious diseases, and poor management and marketing. As a result, the reproductive and productive efficiency is low as illustrated in Table 3.

Table 3 : Average Production Coefficients of Livestock in the Extensive System

Parameter	Goat	Sheep	Cattle
Age at first kidding/lambing/calving (month)	20	20	45
Twinning rate (%)	15	10	–
Kidding/lambing/calving percentage	100	100	50
Kids/lambs/calves born per doe/ewe/cow per life time	6	6	8
Kid/lamb/calf mortality/year (%)	15	18	10
Kidding/lambing/calving interval (month)	12	12	24
Lactation period length (day)	90	–	150
Milk yield per lactation per doe/cow (litre)	22	–	240
Average flock size (No)	6	5	3
Age at slaughter weight (month)	23	20	50
Slaughter weight (kg)	18	25	190

II.26. ***Socio–economic Infrastructure.*** The project area is easily accessible through a seasonal road network and it is 54 km south of the port city of Massawa. Foro is the centre town of the project area, which is found on the main highway (under construction) connecting the two port cities of Eritrea namely Massawa and Assab. People from different ethnic groups inhabit in the area. Table 4 summarizes the percent of households by ethnic group in the project area.

Table 4: Percent of Households by Ethnic Group in the Project Area

Project Site	Saho	Tigre	Afar	Tigrigna	Arab	Total
Zula–Afta	16.6	40.1	39.4	3.1	0.9	100.0
Malka–Adi Umaro	78.5	21.5	–	–	–	100.0
Robrobia	86.5	13.5	–	–	–	100.0
Hadelli–Wia	100.0	–	–	–	–	100.0
Ayromale	98.6	1.4	–	–	–	100.0
Gonfale	73.1	4.5	19.2	–	3.2	100.0
Total Project Area	57.0	22.7	18.3	1.3	0.6	100.0

II.27. In the overall project area about 57 percent of the households are from Saho ethnic group, 23 percent are from Tigre ethnic group, 18.3 percent are from Afar ethnic group. About one percent is from Tigrigna ethnic group and about half percent are Arab/Yemenis. There are Rashaidas that live near the sea and are mainly engaged in fish trade using pick–up vehicles and camels as a means of transport.

II.28. The people in the project area are predominantly subsistence farmers, but in recent times they have fallen to below subsistence levels because of drought. The population livelihood status index of the MoA for the area shows that in 2003, 93 percent of the people are poor. However, the poverty situation has been worsening leading to high dependence on food rations from the government.

II.29. Drinking water is a major problem in the project area. It is inadequate both in quantity and quality. The major human diseases in the area are malaria and diarrhoea with the latter very likely to have high correlation to the poor quality of drinking water in the villages. There is one clinic and two drug stores in Foro serving many of the villages in the project area. Access roads are available in most villages but access to education is restricted to elementary level with the exception of Foro that offers schooling up to grade eight. Students have to go to distant places such as Dekemhare for secondary education and girls do not continue their studies beyond grade five. Market systems are not well developed or organized and storage facilities are very traditional. The major market places for the project area are Ghindae and Adi Keih with a very unreliable and limited market in Foro. There are no industries that offer off–farm employment to farmers in the project area. At present there are very limited credit facilities to farmers in the project area while in the past the *Norwegian Church Aid* (NCA) introduced a credit system for women and *CARE–Vision Eritrea* is involved in providing credit for water pumps. Mercy Corps is presently distributing animal feed on credit basis to farmers in the project area and the repayment is in kind in the form of two year old goats.

III. PROJECT RATIONALE

III.1. The project area has a very harsh or desert like climate with the lowest rainfall and the highest temperature or evapotranspiration rate in the country. It is one of the poorest areas in the country. Over the last six years, droughts of varying degrees have occurred successively, hence it is one of the most vulnerable areas to drought. The area has the lowest socioeconomic infrastructure, particularly drinking water supply for both domestic and livestock purposes.

III.2. The source of livelihood for the population has been destabilized by the loss of livestock production as a main source of income due to the continuous pressure of drought, which indirectly accounts for the chronic shortage of feed and water. Many of the households have lost their breeding stocks and ploughing oxen. This has resulted in shortage of food, cash and animal power for cropping. The spate irrigation practiced to produce crops is also not sustainable due to the inability of farmers to control water flow at both the diversion site and individual fields. Since the early 1970s Zula Dam has failed to serve its purpose as a reservoir for sustainable irrigation due to the fast rate of silting. Some years ago, it was converted to serve as a diversion structures but this did not achieve its objective for technical reasons. As consequence, the population of Afta, Zula, Kadra and others are unable produce spate–irrigated crops (maize, watermelon). This situation has also deprived animals of crop residue feed thereby contributing to lowering their incomes from livestock and crops.

III.3. Upstream of the dam, the farmers have been attempting to develop spate irrigation with traditional methods using plant material and stones, but this effort has also failed to become a means for sustainable food and cash crop production. The fundamental problem is the inability of the farmers to control the river water flow due to lack suitable technology. In addition, the ongoing activities associated with the traditional spate irrigation, including the dam, have been affecting the potentially irrigable land by creating new gullies.

III.4. The fundamental issues affecting food production include drought in the project area, which creates instability in the pastoral system, and crop failure due to the inability of farmers to control river water. Thus, the project would contribute to mitigate the moisture problem.

III.5. The project is in compliance with the framework and the pillars of CAADP because the emphasis given is to produce more cereals and livestock products and integrate soil and water conservation. It is also within the framework of the NMTIP in giving priorities to integrate crop and livestock production to achieve sustainable livelihood.

IV. PROJECT OBJECTIVES

IV.1. The main objectives of the project would be to:

Phase 1:

- increase staple and cash crop production on a sustainable basis by improving water control system and irrigation practices;
- increase food products of animal origin, oxen supply for cropping by restocking, improving nutrition, health and management;
- provide the population and livestock with adequate and sustainable potable water supply;

- develop spate–irrigation to produce food and forage crops;
- prevent soil infertility by controlling soil erosion;
- strengthen the institutional capacity of the stakeholders to effectively manage their resources by training and establishing CBOs; and
- provide farmers with technical information through effective research and extension.

Phase 2:

- increase sustainable water supply availability for both drinking and year round irrigation by constructing new storage dams at upper catchment;
- establish a base for soil and water conservation;
- continue monitoring of river flows and groundwater uses of potential areas as part of environmental management; and
- integrate in the long term the project with the overall coastal development.

V. PROJECT DESCRIPTION

V.1. The project will consist of six sites distributed in the river basins of Alighede, Hadas, Comaile, Gonfale and Hadas–Alighede rivers. In addition to these sites, a new dam has been proposed on Hadas River at the canyon south of Rubrubia village. Some of the components are specific to a site and others are central to all sites. The components include: water, irrigation, soil conservation, crop and livestock production socio–economic infrastructure, research and extension, institutional capacity and the project management.

V.2. The components in each site slightly vary in both numbers and magnitude. The main components will be drinking water for human beings and livestock; and irrigation development for integrated crop/livestock production. The direct support to crop/livestock production model is focused on target groups (households without animals; female headed households; returnees, etc.). The need for intensification, diversification of integrated crop/livestock of production systems based on irrigation, equity among the population members within a basin, and the production of high value products due to the high cost of water have been the basic principles underlying preparation of the production models.

V.3. ***Irrigation Development.*** The project during its five years investment programme would:

- Rehabilitate the existing Foro Dam into a floodwater diversion facility and irrigation water distribution network as it was conceived in previous designs. Two–flood intake structures with a controlling facility will be constructed on the northern part of the dam and on one of the spillways on the southern side. In addition, to reduce the water wasted through conveyance transmission losses, a total of about 8 km and 10 km long primary canals will be rehabilitated. Six division boxes will be constructed at each existing division points. Discharge channel and terminal structure of the main spillway will be constructed with appropriate energy dissipating at the discharge point. This is mainly to protect the village of Unga from flooding.

- Construct a total of five permanent spate diversion works. These structures will divert and regulate spate flows from the main river. They will replace the existing traditional Agum. A facility to exclude sediment from entering the main canal will be provided. The five areas where permanent diversion weirs will be constructed are: Gonfale, Ayromale, Rubrubia, Hidelli–Wia and Malka–Adi Umar. Canals with permanent off–take will be constructed to increase farmer's irrigation water handling capacity and irrigation efficiency.

- A total of 20 wide diameter lined hand dug wells will be constructed mainly for irrigation. Hideli–Wia, Rubrubia and Adi Umar are the major beneficiaries of these activities. A total of 20 pumps and 200 pieces of low–pressure pipes will be distributed to promote groundwater irrigation in the area.

V.4. In addition to the above irrigation development programmes, a detailed feasibility study on the potential of constructing a stream storage dam on the Hadas river on the gorge located at about 3 km upstream of its confluence with Alighede and the possibility of constructing off–stream storage site with proper sediment trapping and excluding facilities is recommended. It is expected that the feasibility study will be carried out during this initial investment period and its implementation to be continued beyond the project duration.

V.5. ***Drinking Water Supply.*** The project would support improving drinking water supplies by:

- Upgrading Wiaa spring water source and deliver potable water at least for eight villages located downstream of the source. A total of 40–km long transmission pipeline with distribution system will be constructed. Existing Foro and Unga reservoirs will be improved and six new strategically located distribution reservoirs will be constructed to supply water to public taps.

- Construction of two dug wells mainly for the villages outside of the spring supply route line (Hidelli, Rubrubia and Fatmaere). Simple community managed pump and distribution systems will be installed and water committees for routine system operation and management will be established.

V.6. ***Soil Conservation.*** In association with the irrigation development programme, soil conservation measures would be undertaken within the lower catchments of Haddas, Alghede, Comaile and Saato. This would include the construction of 1,150 check dams to control gully erosion, hill side terracing of 19,500 km and 1,800 km long of river bank erosion control structure and 840 km^2 of afforestation. In general about 30 percent of the Haddas catchment would be protected during the investment period. However, this programme should continue beyond the investment period and be able to cover the whole Hadas catchment in order to reduce reservoir sedimentation, land degradation and maintain the environment.

V.7. ***Crop Production.*** The aim of the project is to increase agricultural production through an integration of crop and livestock production systems. In the project area each household will have about 1.5 ha of land. One hectare will be used for crop production of both staple food and cash crops such as maize, watermelon and sesame. The half–hectare of land will be used for forage production. The crop production component will include intensive production system, harvesting three times of a year with improved management practice that include sustainable diversion structures, control of gully formation, periodic training of farmers on improved production techniques and farmer demonstrations. The project will provide seeds and farm tools at the initial stage. It will also establish seed multiplication sites for sustainable seed availability.

V.8. ***Livestock Production.*** The project area has potential to produce livestock integrated with the spate irrigated cropping. The pastoral system, which at one time has successfully supported the population in the project area, has almost failed to significantly contribute to the livelihood of the communities. The spate irrigated cropping has also become unreliable to be able to replace the pastoral system. The farmers themselves have started an alternative approach, which is the integration of crop and livestock; however, it is not yet adequately developed to ensure their livelihood.

V.9. Five sites have been selected in the project area for phase–1 development, of which site 1 (Zula/Afta) and site 5 (Gonfale) are located on the Red Sea coast while the remaining are upstream at the foot of the Hadas mountain. In the latter, the potential for water and browsing is higher than that of the coastal sites. In the coastal sites, beneficiary households will each be provided with ten goats while those of the upstream sites will be provided with 15 goats. The system will be semi–intensive where feeding will be based on forage and residue crop produced on–farm. In addition, feed sources will be based on maize stalks, weeds, aftermath grazing and grazing on marginal land during the rainy season.

V.10. The main elements of the approach will be: (a) provision of starting breeding stock; (b) supplying initial seed for forage crops; and (c) establishing veterinary infrastructure; legume fodder plants; water points; and livestock market infrastructure.

V.11. ***Socio–economic Infrastructure.*** This component will include the construction of feeder roads to improve accessibility. It will also involve the provision of credit facilities as well drinking water supply. The major activities will include: provision of credit for oxen, animal feed and seeds; establishment of a maintenance system of existing roads; improvements to the maintenance and repair system of water pumps and other equipments, construction of new feeder roads to inaccessible areas and establishment of a market place or centre in the project area.

V.12. ***Extension.*** This component will provide support to problem solving and demand driven extension support to farmers and CBOs, giving particular emphasis being to cereal and horticultural production integrated with livestock.

V.13. ***Institutional Base.*** Under this component the project will carry out a number of activities to build–up efficient institutions. The approach would be by training of farmers and extension agents; establishing community level organizations or strengthening existing community–based institutions; and boost capacity in water management, maintenance and repair of water equipment.

V.14. ***Project Coordination.*** A project coordination unit will be established to ensure efficient implementation of the project. It will coordinate the activities of various partners involved in project implementation. The organization will be responsible for preparing *Annual Work Plans and Budgets* (AWPBs) and monitoring and evaluation.

VI. INDICATIVE COSTS

VI.1. The project investment costs are presented by component in Table 5. The major costs were based on domestic price quotations. For costing irrigation infrastructure and wells, local standards have been used as a guide, as there are many similar projects in the country. It was assumed that imported materials would not be subject to import taxes and that prices of the domestically produced items would be stabilized. It is also assumed that the government is committed to contribute 10 percent of its share for agriculture. The costs of labour provided by the beneficiaries were based on current domestic prices for labour.

Table 5: Cost Summary per Component					
Component	Local	Foreign	Total (US$)	% Foreign Exchange	% of Total Base Cost
Irrigation Development	2,657,378	23,916,402	26,573,780	90%	56%
Drinking Water Supply Development	456,123	1,944,527	2,400,650	81%	5%
Crop Development	77,022	1,349,317	1,426,339	95%	3%
Soil Conservation	5,368,738	3,432,472	8,801,210	39%	19%
Livestock Development	323,772	5,072,428	5,396,200	94%	11%
Socioeconomic infrastructure	27,480	430,520	458,000	94%	1%
Research and Extension	4,200	295,800	300,000	99%	1%
Institutional Support	200,000	300,000	500,000	60%	1%
Project Coordination	400,000	600,000	1,000,000	60%	2%
Technical Assistance	–	300,000	300,000	100%	1%
Total Base Cost	9,514,713	37,641,466	47,156,179	80%	100%
Physical Contingency	475,736	1,882,073	2,357,809	80%	5%
Price Contingency	951,471	3,764,147	4,715,618	80%	10%
Total Project Cost (US$)	10,941,920	43,287,686	54,229,606	80%	115%
Investment Cost per Beneficiary HH (direct + indirect = 6,377 HH)			*8,504*		

VII. PROPOSED SOURCES OF FINANCING

VII.1. The financing arrangements were based on contributions from government, beneficiary communities and aid agencies. The government cost will include most of the technical and management staff and physical facilities such as offices for implementation. The government will not tax any materials and services imported for use by the project. The arrangement is that the government, in general, will cover costs of local origin and ensure the allocation of the 10 percent counterpart fund obligation. The communities will contribute their share of project cost through the provision of labour in labour–intensive components or activities. The foreign financing agencies are generally expected to meet the costs of equipment, technical assistance and major physical construction.

VIII. PROJECT BENEFITS

VIII.1. The benefits would be financial, economic, social and institutional. From the financial stand point, the farmers will be gaining cash income from sales of meat and milk to complement the energy food. Economic benefits for the country will be by contributing to the national development programme and the national food supply. The benefits from the social aspect will be equity in incomes and improve child nutrition (milk). From the environment perspective, the project will benefit from improved soil fertility.

VIII.2. ***One Year Farm Budget.*** The following farm budget for three commodities was prepared under the assumption that a farmer has three harvests per year as to their crop calendar. Cost calculations were made taking into account the data provided by farmers and the experts' estimation of input costs and returns from each commodity. In addition market conditions for the different commodities were also considered for purposes of safety margin. Farming in the area is based on spate irrigation and through diversion.

VIII.3. At present the average yield per hectare for maize is estimated to be 13 quintals while for watermelon it is 30 quintals. With the project the yield would increase to 20 quintals for maize and 40 quintals for watermelon. Improved moisture conditions, timely pest control and improved cultural practices due to the project will have their impact both on the quantity and quality of output. Thus farmers' income would improve and contribute to poverty reduction in the area. Although the crop budget indicates high potential for profits, a detailed economic and financial analysis of the project should be undertaken.

Table 6: Crop Model – 1.0 ha

Item	(US$)
Fixed Costs	
Cost of diversion	100
Cost of farm tools	10
Total Fixed Costs	110
Variable Costs	
Cost of seed (maize)	7
Cost of seed (watermelon)	55
Cost of seed (dura)	4
Cost of oxen power (maize)	47
Cost of oxen power (watermelon)	48
Cost of oxen power (dura)	48
Cost of labour (maize)	203
Cost of labour (watermelon)	125
Cost of labour (dura)	60
Cost of pesticides (watermelon)	89
Transport costs (maize)	44
Transport cost (watermelon)	59
Transport cost (dura)	20
Total variable Costs	809
Total Expenditure	919
Returns	
From maize (20 quintals @ US$52)	1,033
From watermelon (40 quintals @ US$22)	886
Expected income from dura (20 quintals @ US$15)	300
Value of crop residue (lump sum)	74
Total Returns	2,293
Gross Profit	1,374

VIII.4. It is important to note that the expected useful life of wells, dams and reservoirs (diversion structure) is assumed to 25 years. Pumps have useful life of 20 years and pipes are expected to be serving for 15 years. Accordingly 1 percent of the cost of construction of wells, 1 percent of diversion costs, 1 percent of the cost of pipes and 4 percent of the cost of pumps are the direct costs of production which are considered in the farm budget per year.

IX. IMPLEMENTATION ARRANGEMENTS

IX.1. The project will be implemented within the framework of the concerned government agencies using the existing government institutional arrangements as much as possible. It will involve several partners; hence it will require maximum coordination. For this purpose, it will be provided with an efficient coordinating unit. A steering committee will be formed from among the partners with the function of overseeing that project implementation is within the planned time and budget framework. The main partners will be the regional administration, the MoA and the CBOs. The

coordinating unit will be responsible for routine activities such as financial management, monitoring and evaluation and preparing *Annual Work Plans and Budgets* (AWPBs). It will be responsible to the steering committee. The beneficiary committee will form CBOs for the various project functions by establishing committees. The CBOs will participate in planning, deciding, implementing and monitoring and evaluation functions. The specific roles and responsibilities of the different ministries and the local government and other parties involved in project implementation and its monitoring will be clarified and defined more precisely at the time of project preparation.

X. TECHNICAL ASSISTANCE

X.1. The project will require long–term technical assistance in irrigation systems design and water management. Short–term technical assistance will be required in animal production.

XI. ISSUES AND PROPOSED ACTIONS

XI.1. There are a number of issues that will require clarification prior to finalization of the project:

- ***Irrigation.*** The design of spate irrigation involves complex design and the use of competent personnel with adequate experience because it requires extensive knowledge of the traditional system. To ensure that appropriate designs are produced, adequate data on similar on similar accomplished projects should be also collected and analysis undertaken. For this purpose a follow up study must be carried out before the planned feasibility study.

- ***Crop and Livestock Models.*** The models presented in this project profile have been prepared based on local knowledge and science, but since this is just an entry point in transforming the traditional production model into an improved model, the parameters taken to prepare the models (production and economic) must be further detailed and tested by carrying out direct observations and involving the beneficiaries.

- ***Soil Conservation Techniques.*** The project area is hot and arid. The conservation techniques and in particular the plants to be used must be determined scientifically. There has been experience in this country, but the viability of such techniques needs to be tested. It is also important to ensure that the will of the community to participate in this activity.

- ***Scarcity of Farm Labour.*** This is an evolving problem, particularly for livestock as more and more children attend school and are unavailable for on–farm activities.

- ***Organization and Function.*** The implementing body which is likely to be the *Red Sea Region Administration* must start to effectively establish the required organizational set up and engage qualified personnel at the project area, regional and national levels. It must also ensure that a competent authority is established for project coordination. The formation of CBOs and their training must be made early enough. The project will require several local committees to run irrigation water, land and other management activities.

- ***Link with Funding Agencies.*** It is essential that clarity is made on how the aid agencies are to participate in the project.

- ***Environment.*** The project area is arid and hence environmentally fragile. It is necessary that an *Environmental Impact Assessment* (EIA) of the project area is conducted. According to the *National and Environment Assessment Procedure and Guidelines* issued in 1999 the project area is located within the designated environmentally sensitive area because of the existence of the ancient port towns of Adulis and Zula. Therefore, it is a must to conduct a complete EIA prior to the implementation of the project.

  The ZPIDP–1 project is located along the Red Sea Coast and covers all the existing spate irrigated alluvial plains starting from the mouth of Hadas, Alighede and Comaile rivers to the point where the streams are discharging their flows into the Red Sea. Therefore, the proposed project flood water diversions could have an environmental impact on the flora and fauna of the Red Sea shore near the Gulf of Zula and this impact should be assessed and the necessary mitigation measures should be identified before the implementation of the project.

XII. POSSIBLE RISKS

XII.1. Possible risks that may negatively affect project implementation include:

- ***Irrigation Water.*** There is inadequate data on the flows of the rivers designated to be used for the proposed spate irrigation schemes. Thus the risk of variation in irrigation water volume and river flow occurrences should be considered and further study should be made.

- ***Delays in Implementation.*** A risk of not implementing the project within the planned time framework may occur.

- ***Availability of Competent Personnel.*** It is likely that competent and experienced personnel may not be locally available to coordinate, manage and lead this project and in particular irrigation.

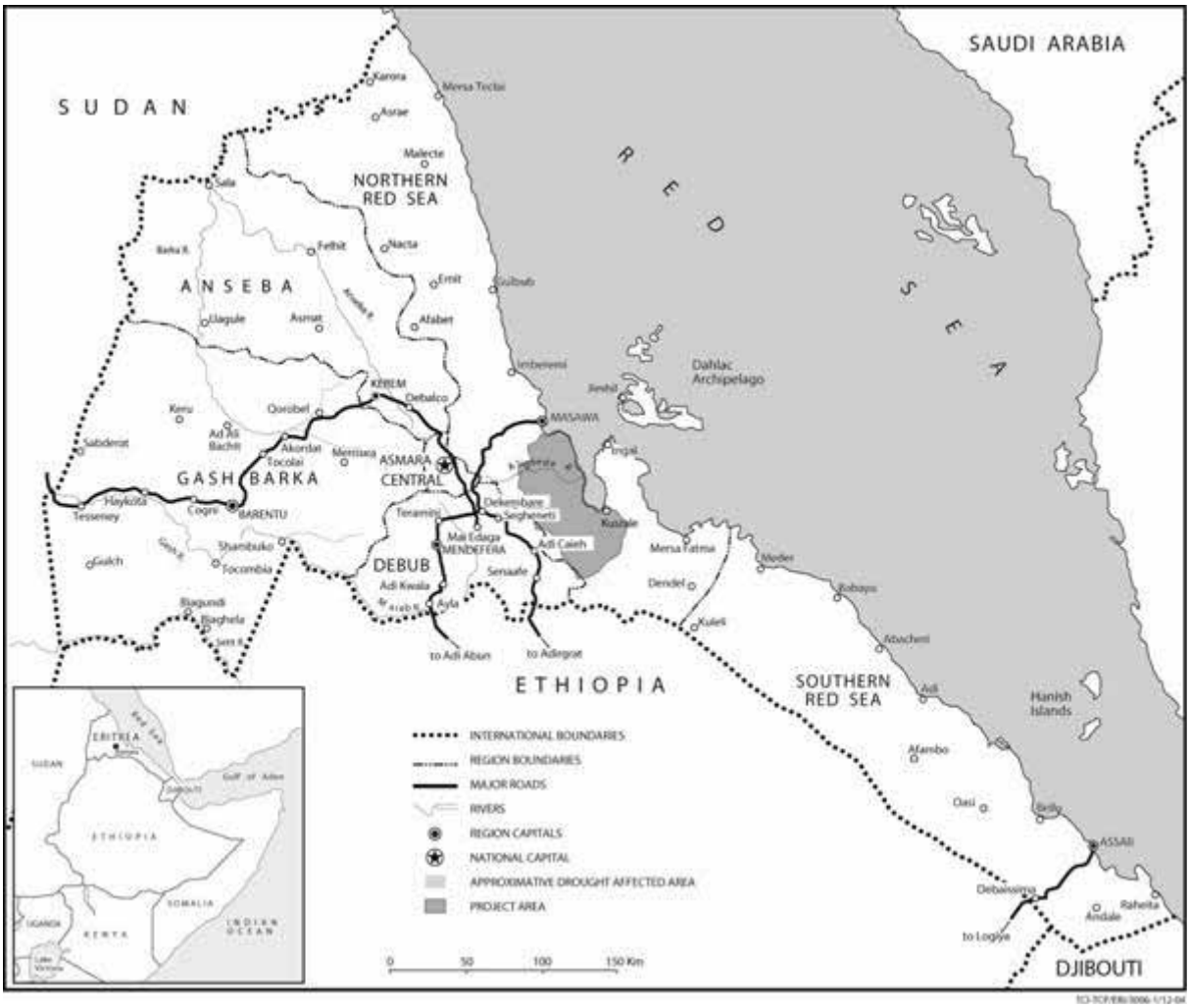
ANNEXES:

Annex 1: Map of Eritrea Showing Location of Project Area

Annex 2: Livestock Component Indicative Financial Returns

Annex 3: Production Cost of Some Crops Used to Calculate the Financial Results

Annex 1: Map of Eritrea Showing Location of Project Area



Annex 2: Livestock Component Indicative Financial Returns

Goat Production Model (20 Does/HH)

Production Coefficients	Value
Total does (Nº)	20
Total buck (Nº)	2
Fertility rate (%)	90
Kids/doe/year (Nº)	1.8
Kid mortality/year (%)	2
Twining rate (%)	20
Breeding doe replacement per annum (%)	15
Milk yield/doe/day (kg)	1.2
Lactation period (day)	90
Slaughter age (month)	12
Liveweight at slaughter age (kg)	30

Farm Budget (HH)				
	Unit	Qty.	Value (Nakfa)	
			Unit	Total
Income:				
Meat (lbw basis)				
Bucks: 14 bucks/year production @ 30 kg lbw each	Nº	14	650	9,100
Culls: 3 culls/year	Nº	3	500	1,500
Breeding does (yearling): 12 per year	Nº	12	650	7,800
Milk: 0.8 kg/doe/day after kid feeding; (90 x 1.8 = 162 days) = 130 kg/doe/year; 18 milking does = 2,340 kg milk/year	kg	2,340	6.5	15,210
Manure	t	2	600	1,200
Total Income				34,810
Expenses:				
Feed:				
Roughage PM	t	1.4	3,000	4,200
Supplement	t	0.5	10,000	5,000
Veterinary	Nº	40	25	1,000
Labour (family)	person–day	365	25	9,125
Miscellaneous				3,000
Total Expenses				22,325
Profit (before tax)				12,485

Project Area Total Annual Financial Result

Total HH	2,200
Total return/HH (Nakfa)	12,485
Total annual financial return of project area (Nakfa)	27,467,000

ASSUMPTIONS:

- *The prices of outputs taken to estimate the indicative financial results were about 30% lower than the actual prices in Eritrea during the last quarter.*
- *The prices of inputs taken were those of the years before the Eritro–Ethiopian war (1997) because current prices are too inflated to be representative.*
- *It is assumed that input and output price increases will balance with each other.*
- *The production coefficients given were based on wide experience in Eritrea comparing the typical traditional system with those improved systems. In effect, about 20% safety margin has been given in most cases.*
- *Exchange rate: 1.00 US$ = 19.00 Nakfa.*

Annex 3: Production Cost of Some Crops Used to Calculate the Financial Results

Cost of Production for Maize				
Item	Unit	Qty.	Cost (Nakfa)	
			Unit	Total
Seed cost	kg	40	10	400
Dyke maintenance	oxen days	5	80	400
Spate irrigation cost	person–day	5	50	250
Ploughing	oxen days	8	80	640
Seeding	oxen days	4	80	320
Weeding	person–day	20	50	1,000
Harvesting labour	person–day	15	50	750
Threshing	person–day	20	50	1,000
Transport to market	quintal	20	30	600
Total costs				5,360
Yield per hectare	quintal	20	700	14,000
Net benefit per ha				8,640

Cost of Production for Water Melon				
Item	Unit	Qty.	Cost (Nakfa)	
			Unit	Total
Seed cost	kg	3	250	750
Dyke maintenance	oxen days	2	80	160
Land preparation (ploughing)	oxen days	8	80	640
Irrigation	person–day	2	50	100
Weeding/cultivation	person–day	20	50	1,000
Insecticide	litre	3	200	600
Fungicide	litre	3	200	600
Labour for spraying	person–day	2	50	100
Harvesting labour	person–day	12	50	600
Transport to market	quintal	40	20	800
Total costs				5,350
Yield per hectare	quintal	40	300	12,000
Net benefit per ha				6,650